

Serial No. 10/715,825
Amendment Dated: June 20, 2006
Reply to Office Action Mailed: March 20, 2006
Attorney Docket No. 038871.52947US

Amendments to the Drawings:

The attached sheet of drawings includes changes to Figures. 1 and 2 to include the legend "Prior Art", and to Figures 3 and 4 submitted in compliance with PTO drawing requirements.

Attachment: Replacement Sheet

REMARKS

In response to the objection to the drawings, as set forth on page 2 of the Office Action, Applicants have submitted herewith a replacement sheet bearing Figures 1 and 2, to which the legend "Prior Art" In addition, a replacement sheet bearing Figures 3 and 4 is also submitted, with the replacement sheets being in compliance with PTO drawing requirements.

Claims 3 and 13 have been rejected under 35 U.S.C. § 112, second paragraph for allegedly failing to particularly point out and distinctly claim the invention, based on certain formal issues identified by the Examiner at pages 2 and 3 of the Office Action. In response to these grounds of rejection, Applicants have amended Claims 3 and 13 in a manner which addresses and is believed to resolve the cited formal issues. In addition, Applicants have also reviewed and revised the remaining claims in order to put them in a form which is more customary in U.S. practice, and to obviate any further formal issues.

Claims 1, 2, 5-11, 15, 16 and 17 have been rejected under 35 U.S.C. § 102(e) as anticipated by Stautner (U.S. Patent No. 6,490,871, hereinafter referred to as Stautner '871), while Claims 3, 4, 12-14 and 18 have been rejected under 35 U.S.C. § 103(a) as unpatentable over Stautner '871. In addition, Claims 1, 2, 7-10 and 17 have been rejected as unpatentable over Jeker et al. However, for the reasons set forth hereinafter, Applicants respectfully submit

that all claims of record in this application now distinguish over the cited references, whether considered separately or in combination.

The present invention is directed to a pulse tube refrigerator which is integrated with a bath cryostat containing liquid cryogen and a superconductive magnet. In particular, the apparatus according to the invention includes a cryogenic chamber having an outer vacuum vessel, an inner cryogen vessel, a turret housing a neck tube that provides external access to the inner cryogen vessel, and a pulse tube refrigerator which has at least one pulse tube and at least one regenerator tube. The pulse tube refrigerator is located within a vacuum contained between the outer vacuum vessel and the inner cryogen vessel, and is collocated with the neck tube, within the turret.

Although the pulse tube refrigerator 20 shares the same turret as the helium neck, 8, it is not placed within the helium neck tube. Rather, the pulse tube refrigerator is connected externally to the helium neck tube. This arrangement permits a smaller diameter neck tube to be used, reducing the rate of parasitic influx of heat towards the helium vessel 11. Furthermore, the pulse tube refrigerator 20 cools the helium neck tube 8, thereby essentially eliminating helium boil-off under normal operating conditions.

The Stautner '871 corresponds to UK patent GB 2 330 194, which is referred to at page 2, line 12 of the present application, and described at page 2, lines 11-29. It discloses a combined neck-tube pulse tube refrigerator, in which

the pulse tube refrigerator forms a “liner” within the neck tube. In particular, it does not teach or suggest that the pulse and regenerator tubes are displaced away from the neck tube. In fact, quite to the contrary, because at least one of the pulse tube and regenerator tube forms or lines the neck tube. With particular reference to Figure 6, an annulus 52 is shown, housing pulse and regenerator tubes 30 and 32. The interior of the annulus forms the neck tube. (See description, Column 6, lines 52-55, which states that, “pulse tubes 30 and regenerator 32 ...occupy a part or section of the neck tube 52”.) Therefore, the pulse and regenerator tubes cannot be described as “displaced away” from the neck tube, as required by Claim 1, for example.

The configuration of Stautner ‘871, in which the pulse tube refrigerator is placed inside the neck tube, is the opposite of the present invention, in which the pulse and regenerator tubes are placed outside the neck tube and displaced away therefrom. (Thus, for example, the last two lines of Claim 1 recite that the at least one pulse tube and the at least one regenerator tube “are displaced away from the neck tube and from each other”. Accordingly, Claim 1 distinguishes over Stautner ‘871 for this additional reason as well. Claim 2 is similarly limited.

The Jeker et al reference, on the other hand, discloses an arrangement which corresponds to the representative prior art illustrated in Figure 1 of the present application, in which the refrigerator occupies one turret, and cools the

cryogen vessel and the thermal shield, while the thermal shield is also linked to the neck tube. The refrigerator is thus not "rigidly mechanically connected" to the neck tube, as required by the claims of the present application, as the refrigerator is connected to the neck tube through radiation tube shield 39, and "spirally shaped slotted coupling element" 30. The refrigerator and the neck tube do not share a single turret, as also required by the claims of the present application. Rather, the refrigerator has its own turret 15 and the neck tube occupies a different turret 38.

As noted previously, the advantage of the present invention relative to the prior art illustrated by the Stautner '871 and Jeker et al references is that it permits a reduction in the diameter of the neck tube, which is cooled by the refrigerator. As a result, thermal influx through the material of the neck tube is reduced, as discussed, for example, at page 9, lines 23-26. The prefabricated assembly of Claim 2 also provides significant advantages in ease of manufacturer of the completed cryostat, for example as described at page 8, line 14 through page 9, line 23. This arrangement also simplifies the assembly process, compared to that of the prior art described on page 9, line 24 through page 10, line 4. Moreover, by locating the pulse tube and the refrigerator tube away from the neck tube, in contrast to the teachings of Stautner '871, improved operational efficiency of the refrigerator is obtained, as described in the specification, for example, at page 10, lines 5-21. By mechanically linking the neck tube with the

pulse and regenerator tubes, effective cooling of the neck tube is provided, and assembly of the cryogen vessel is simplified.

In light of the foregoing remarks, this application should be in condition for allowance, and early passage of this case to issue is respectfully requested. If there are any questions regarding this amendment or the application in general, a telephone call to the undersigned would be appreciated since this should expedite the prosecution of the application for all concerned.

If necessary to effect a timely response, this paper should be considered as a petition for an Extension of Time sufficient to effect a timely response, and please charge any deficiency in fees or credit any overpayments to Deposit Account No. 05-1323 (Docket #038871.52947US).

Respectfully submitted,



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Attachments – Replacement Sheets (Figures 1, 2, 3 and 4)
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